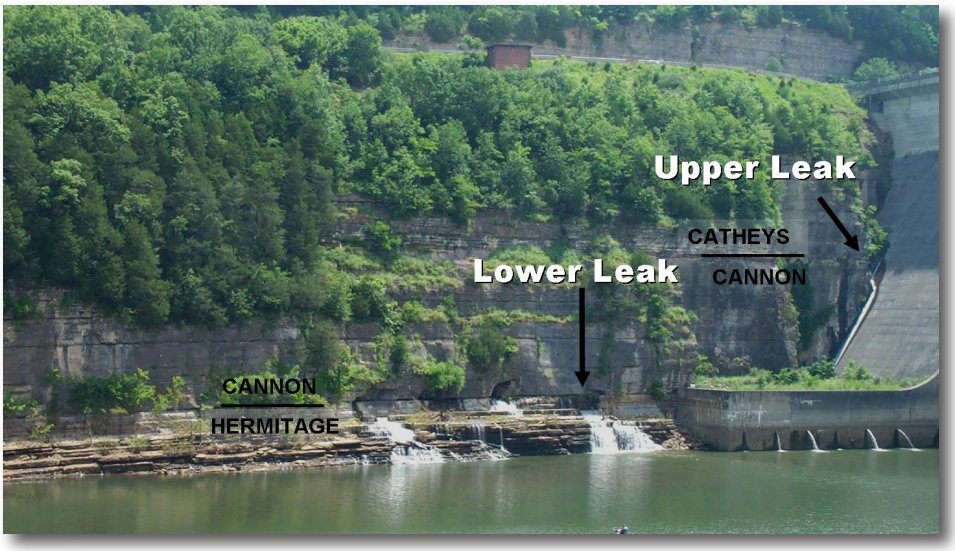
Seepage

Center Hill Dam was designed and built in the 1940's on a limestone foundation with joints, caves, and fractures. Small amounts of water move under and through the dam, seeking a path of least resistance. This movement is called seepage. All dams have some seepage; however, seepage must be controlled to keep the dam safe.

The area around the dam site is riddled with caves, sinkholes and pits characteristic of the *karst* geology in the area. Original designers recognized the dam would need continual maintenance to keep the dam safe, as seepage was first apparent within two years of construction. The Corps has closely monitored and maintained Center Hill Dam over the years and has pumped grout into the foundation to slow and control the seepage. Grout is generally a mixture of cement and water that can be pumped under pressure into the foundation to fill up cracks in the rock and close any openings.

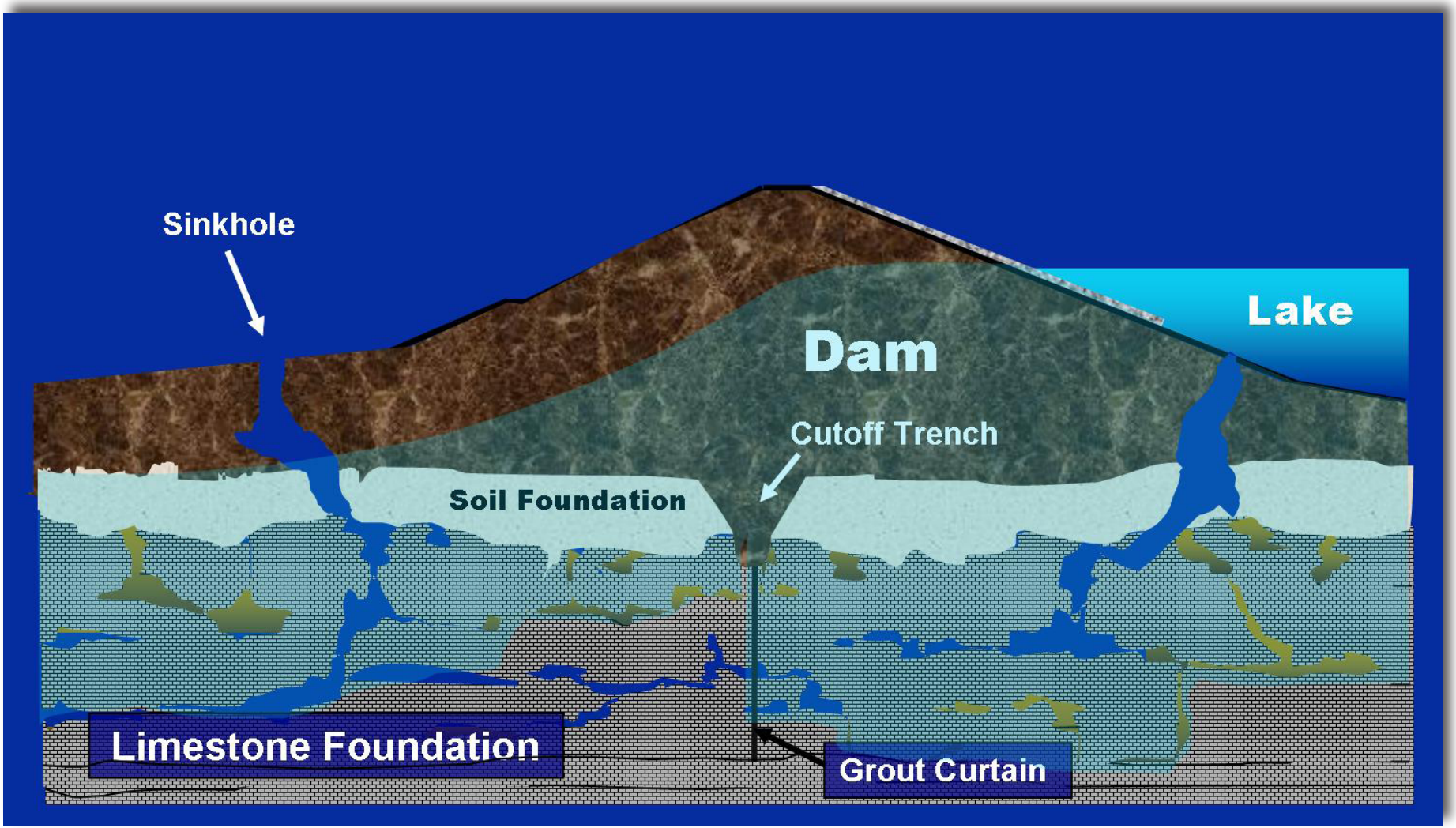
Following several years of high lake elevation, we first noted and began to monitor several sinkholes downstream of the left rim. This is the largest, about 25-feet in diameter when found in 1992. We dug into the sinkhole in 1999 to map and better understand how to close the opening from the lake to the sinkhole. The rock joints were filled with clay. We flagged and continued to monitor the area. In the spring of 2003, with a high lake elevation (over 672), the bottom clay began to sink and clay material was washed out of the picnic spring.

The foundation of Center Hill Dam continues to deteriorate as the water moving through slowly washes out the clay inside the cracks and fractures. Current seepage indicators include active piping (movement of soil material by water) and sinkholes (first noted in the mid 1990's) along open features within the rims. Indicators of serious seepage through the foundation of the main dam and saddle dam currently include abnormal piezometer (pressure gauges in the foundation rock) levels, wet areas, and increasing flow in springs.



Seepage has been visible in the right bluff for many years. The upper leak began within 2 years of impoundment in the mid 1950's; the lower leak began 17 years after impoundment. These features represent a water loss problem and do not endanger the stability of the dam. We plan to address these features to control them while they are manageable.

If left untreated, seepage could seriously threaten the stability of the dam, causing an emergency situation. Failure of Center Hill Dam would cause damages in excess of $1 billion, as well as loss of life. Although we believe there is no imminent danger to the structure, the repairs need to be completed now to ensure the long-term safety of the dam. Completion of the dam repairs will extend the project life well into this century, resulting in continued long-term project benefits.



This illustrates a simplified cross-section of the earthen portion of the dam and the foundation. It further illustrates the danger of an inadequate foundation in karst geology. The brown area represents the large compacted clay embankment at Center Hill. It is well constructed in 4 to 6-inch lifts and sits on soils that were left in place. Beneath the soil is the karst limestone with open and clay-filled, sand or silt-filled cracks and joints called features. Lake water normally moves slowly through and under the earthen part of the dam. As water moves normally through the foundation, it begins to remove the materials from these features, allowing more water to move through faster and further, eroding the materials in the interconnected features. When one of these features opens to the surface, overlying material falls into the cavities and is washed downstream, causing a sinkhole at the surface. When the openings lead back to the lake, this is a very serious situation because there can be a direct connection from the reservoir to the downstream side, with water flowing under the dam unchecked.